BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
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In the Matter of	
	WC Docket No. 17-108
"Restoring Internet Freedom"	

REPLY COMMENTS OF SCOTT JORDAN

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1. BROADBAND INTERNET ACCESS SERVICE INVOLVES TELECOMMUNICATIONS

The *NPRM* claims that "Internet service providers do not appear to offer 'telecommunications'".[1] I defer the question of the "offering" until section 6 of these comments. However, there is no doubt that broadband Internet access involves telecommunications. Before asking whether broadband Internet access service offers telecommunications, the Commission should first determine which components of the service constitute telecommunications. The *NPRM* asserts that the transmission of information is not telecommunications. In this section, I address that assertion.

A. Users specify the points between and among which information is transmitted.

The *NPRM* asserts that "broadband Internet users do not typically specify the 'points' between and among which information is sent online".[2] This assertion is based on several underling assertions, all of which are factually wrong or irrelevant. I address these in turn.

First, to justify this assertion, the *NPRM* notes that "domain names must be translated into IP addresses". This is irrelevant. Although the translation may be provided by a broadband Internet access service provider's DNS server, that server is not itself specifying the IP address. That server is merely relaying the IP address that the owner of the domain name specifies to map to that domain name.[3] Thus, the IP address of the other party is specified by the other party, not by the broadband Internet access service provider.

Furthermore, the domain name to IP address translation occurs before the transmission of information of the user's choosing.[4] When an end user starts an application and requests a connection to a specific domain name, that application issues a DNS query for the associated IP address. (The process is detailed in section 3.A below.) Only after receiving the desired IP address does the application initiate the connection to the domain. By the time of this transmission, the user (or the application acting on behalf of the user) knows the IP address of the other party. Thus, the transmission of information of the user's choosing is between or among points specified by the user.

The *NPRM* also asserts that "IP addresses may not specify where information is transmitted to or from because caching servers store and serve popular information". This assertion is factually wrong. When information is cached by a content delivery network, the IP address to be used in retrieving that content is specified by the content provider (or by the content delivery network provider, acting on behalf of the content provider), not by the broadband Internet access service provider. Furthermore, the domain name to IP address translation occurs before the transmission of information of the user's choosing.[5] By the time of this transmission, the user (or the application acting on behalf of the user) knows the IP address of the content. Thus, the transmission of information of the user's choosing is between or among points specified by the user.

The *NPRM* also asserts that "the Internet service provider specifies the points between and among which information will be transmitted". This assertion is factually wrong. As discussed in the previous three paragraphs, the broadband Internet access service provider does not specify the IP address of the other

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[1] "*Restoring Internet Freedom*", Notice of Proposed Rulemaking, 32 FCC Rcd. 4434 (*NPRM*), para. 29.
[2] *NPRM*, para. 29.
[3] Internet Engineering Task Force, Domain Names – Concepts and Facilities, RFC 1034 (Nov. 1987), https://tools.ietf.org/html/rfc1034 (*DNS Standard: Concept and Facilities*) at 18-19; Internet Engineering Task Force, Domain Names – Implementation and Specification, RFC 1035 (Nov. 1987), https://tools.ietf.org/html/rfc10345 (*DNS Standard: Implementation and Specification*) at 4-5.
[4] James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach (Pearson, 7th ed. 2017) (*Kurose*) at section 6.7.
[5] *Kurose* at section 6.7.

party. The end user (or the application acting on behalf of the user) specifies the IP address of the other party, and that IP address is conveyed to the application by the edge provider.

It is also worth noting that the Commission's *Advanced Services Order* determined that xDSL-based advanced service was telecommunications, and hence that in that service users specified the points between and among which information is transmitted. None of the ensuing classification orders disturbed this finding. Furthermore, the DNS standards had been in place long before the *Advanced Services Order*, and nothing has since changed about DNS to reverse this finding.

B. Broadband Internet access service transmits information without change in the form or content of the information as sent and received.

The *NPRM* asserts that "Internet service providers routinely change the form or content of the information sent over their networks—for example, by using firewalls to block harmful content or using protocol processing to interweave IPv4 networks with IPv6 networks".[6] The *NPRM* further asserts that "consumers want and pay for these functionalities that go beyond mere transmission—and that they have come to expect them as part and parcel of broadband Internet access service."[7]

There are four separate issues here that should be addressed separately. First, does broadband Internet access service routinely change the form or content of the information transmitted? Second, if so, what effect does this have on the scope of the underlying telecommunications? Third, if broadband Internet access service does routinely change the form or content of the information transmitted, do the functionalities that change the form or content fall within the telecommunications systems management exception, and are therefore part of the telecommunications service? Fourth, if broadband Internet access service does routinely change the form or content of the information transmitted, and if such functionalities do not fall within the telecommunications systems management exception, is the underlying telecommunications separable from such functions?

I will address in this section the first three questions for each of the functionalities discussed in the *NPRM*. I defer the fourth question, about separability, until section 6.

i. Firewalls do not convert broadband Internet access service into an information service.

The assertion that broadband Internet access service providers "routinely change the form or content of the information sent over their networks … using firewalls to block harmful content" is factually wrong. It is important to distinguish between (i) security functions that a broadband Internet access service provider implements for the management of the broadband Internet access service or the management, control, or operation of the telecommunications system used to provision broadband Internet access service, and (ii) the security functions that a broadband Internet access service provider offers to end users by bunding security software with its broadband Internet access service.

In the former case, such security functions block traffic to implement reasonable network management, e.g. to protect a broadband Internet access service providers own network by blocking denial of service attacks. Such security functions do not change the form or content of information. More importantly, such security functions typically block traffic that is not of the user's choosing, as they affect attack traffic, not normal user traffic. The security function itself remains a component of the telecommunications service, since as reasonable network management it clearly falls within the telecommunications systems management exception.

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[6] *NPRM*, para. 30.
[7] *NPRM*, para. 30.

In the latter case, e.g. virus and/or firewall software bundled with broadband Internet access service, it is the virus and/or firewall application – not the broadband Internet access service provider – that changes the form or content of information. Furthermore, it is not "routine", as it affects only attack traffic, not normal user traffic. More importantly, such an application is not part of the broadband Internet access service.[8] It is a separable information service, as I'll address in section 6.

The *NPRM* asks "[h]ow could we plausibly conclude that it is not a 'change in the . . . content' to use firewalls and other reasonable network management tools to shield broadband Internet users from unwanted intrusions and thereby alter what information reaches the user for the user's benefit?"[9] Security functions that a broadband Internet access service provider implements for the management of the broadband Internet access service or the management, control, or operation of the telecommunications system used to provision broadband Internet access service fall within the telecommunications systems management exception. The security function thus remains part of the telecommunications service. Other reasonable network management practices that shield broadband Internet access users from unwanted intrusions are first and foremost practices "that have a primarily technical network management justification".[10] By definition, such practices fall within the telecommunications systems management exception.

ii. Protocol conversion does not convert broadband Internet access service into an information service.

The assertion that broadband Internet access service providers "routinely change the form or content of the information sent over their networks … using protocol processing to interweave IPv4 networks with IPv6 network" is irrelevant. The broadband Internet access service provider determines whether the IP address assigned to an end user's modem is an IPv4 or an IPv6 address. When a broadband Internet access service provider assigns an IPv6 address, it does this for the broadband Internet access service provider's benefit, not for the end user's benefit. The end user sees no benefit to such an assignment. However, when a broadband Internet access service provider assigns a customer an IPv6 address, the broadband Internet access service provider must then convert traffic to and from this customer between IPv4 and IPv6 formats, in order to carry out the broadband Internet access service, namely to transmit data to and receive data from all or substantially all Internet endpoints. The protocol conversion is incidental to and enables the operation of the communications service. Thus, although the protocol conversion itself may not constitute telecommunications, the protocol conversion function falls within the telecommunications systems management exception and is thus part of the telecommunications service.

There is a long history that supports this analysis. Under *Computer II*, protocol conversion is similarly part of a basic service when it is used to facilitate the transmission of information, and part of an enhanced service when it is used to act on the subscriber's transmitted information. Protocol conversion for the purpose of transmitting information without change in form or content is part of the basic transmission service. In contrast, protocol conversion for the purpose of "allowing disparate terminals to communicate with one another" is an enhanced service.[11] The *MFJ* and the *1996 Act*, by establishing the telecommunications systems management exception, maintained this distinction.

In today's Internet, all end user devices are capable of communicating using IPv4. They only use IPv6 when assigned an IPv6 address by the broadband Internet access service provider. Protocol conversion between

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[8] *Protecting and Promoting the Open Internet*, Report and Order on Remand, Declaratory Ruling, and Order, 30 FCC Rcd 5601 (2015) (*2015 Open Internet Order*), para. 373.
[9] *NPRM*, para. 30.
[10] *2015 Open Internet Order*, para. 215.
[11] *Amendment of Section 64.702 of the Commission's Rules & Regulations (Second Computer Inquiry)*, Final Decision, 77 FCC 2d 384 (1980) (*Computer II*), para. 99.

IPv4 and IPv6 does not serve the purpose of allowing disparate terminals to communicate with one another. The end user devices are not disparate terminals. They can communicate with one another without protocol conversion if the broadband Internet access service providers assigns both devices IPv4 addresses or assigns both IPv6 addresses. Protocol conversion is only required if one device is assigned an IPv4 address and the other device is assigned an IPv6 address. In this case, the purpose of protocol conversion is not to allow disparate terminals to communicate with one another; it is to solve a problem created by the broadband Internet access provider itself.

The *Non-Accounting Safeguards Order* maintained this distinction. In addition, it clarified that "protocol processing … in connection with the introduction of a new basic network technology (which requires protocol conversion to maintain compatibility with existing CPE)" is treated as a basic service.[12] The use of IPv6 is exactly that – a new basic network technology which requires conversion between IPv4 and IPv6 to maintain compatibility with existing CPE. None of the later classification proceedings disturb this analysis.

C. The end-to-end transmission of IP packets is telecommunications.

The *NPRM* proposes to reclassify broadband Internet access service as an information service. All information services are "via telecommunications". The *NPRM* fails to identify the component of broadband Internet access service that constitutes telecommunications.

The core component of broadband Internet access service is the end-to-end transmission of IP packets.[13] Telecommunications is "the transmission, between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received."[14]. There is no doubt that the end-to-end transmission of IP packets is transmission of information of the user's choosing. In section 1.A, I have established that this transmission is between or among the points specified by the user. In section 1.B, I have established that this transmission is without change in the form or content of the information as sent and received. It follows that the end-to-end transmission of IP packets is telecommunications.

2. BROADBAND INTERNET ACCESS SERVICE DOES NOT OFFER INFORMATION SERVICE CAPABILITIES OTHER THAN THOSE THAT FALL WITHIN THE TELECOMMUNICATIONS SYSTEMS MANAGEMENT EXCEPTION

The *NPRM* asserts that "Internet service providers offer the 'capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications'" because "broadband Internet access service appears to offer its users the 'capability' to perform each and every one of the functions listed in the definition".[15]

The *NPRM* misconstrues the meaning of "the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications".

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[12] *Implementation of the Non-Accounting Safeguards of Sections 271 and 272 of the Communications Act of 1934, as Amended*, First Report and Order and Further Notice of Proposed Rulemaking, 11 FCC Rcd 21905 (1996) (*Non-Accounting Safeguards Order*), para. 106.

[13] One end is the end user's modem, and the other end is the Internet endpoint with whom the end user is communicating.

[14] 47 U.S.C. § 153(50).

[15] *NPRM*, para. 27.

The service must itself offer such a capability. It is not sufficient that the service enables the use of other services that offer such capabilities.

The entire history of Commission actions and court decisions supports this analysis. Under the *MFJ*, RBOCs could offer telephone exchange service, but were prohibited from offering information services. Telephone exchange service enables the use of information services via the telephone exchange service. For instance, telephone exchange service enables an end user to perform acquisition of information, namely the information transmitted via the telephone exchange service. Telephone exchange service also enables an end user to perform storing of information, e.g. using an answering machine. But clearly this does not make telephone exchange service an information service.

The *1996 Act* incorporated the *MFJ*'s list of capabilities. Telecommunications service offers transmission of a user's information, while an information service offers an application that provides the user with additional information, transformed information, and/or interaction with information. When a telecommunications service underlies an information service, the telecommunications service does not itself offer such capabilities, and thus the existence of information services that offer such capabilities via the telecommunications service does not convert the telecommunications service into an information service under the *1996 Act*.

None of the ensuing Commission actions or court decisions alter this analysis. The *Stevens Report* concluded that dial-up Internet access service was an information service because ISP-provided webpage hosting[16], webpage caching[17], and email[18] offered such capabilities, not because dial-up Internet access service enabled an end user to utilize third party information service applications.[19] The *Cable Modem Declaratory Ruling* similarly noted that the *Stevens Report* observed that some of the applications included in cable modem service – hosting of a subscriber's webpage, caching of newsgroup articles, and email – offer a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information.[20] The *Wireline Broadband Classification Order* similarly clarifies that wireline broadband Internet access service was classified as an information service only because it offered such capabilities itself.[21]

The assertion that broadband Internet access service providers offer the capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications is thus factually wrong. Broadband Internet access service enables end users to utilize information services. These information services offer the capability for generating, acquiring, storing,

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[16] *Federal-State Joint Board on Universal Service*, Report to Congress, 13 FCC Rcd 11501 (1998) (*Stevens Report*), para. 76.

[17] *Stevens Report*, para. 76.

[18] *Stevens Report*, para. 78.

[19] Noteworthy, the Report does not examine whether webpage hosting, caching of webpages and newsgroup articles, or email by a dial-up Internet access service provider is used for the management, control, or operation of a telecommunications system or the management of a telecommunications service. If so, such a capability would not render the service as an information service.

[20] *Internet Over Cable Declaratory Ruling et al.*, Declaratory Ruling and Notice of Proposed Rulemaking, 17 FCC Rcd 4798, 4801 (2002) (*Cable Modem Declaratory Ruling*), paras. 37-38. It also failed to analyze whether the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information falls within the telecommunications systems management exception.

[21] See *Appropriate Framework for Broadband Access to the Internet Over Wireline Facilities et al.*, Report and Order and Notice of Proposed Rulemaking, 20 FCC Rcd 14853 (2005) (*Wireline Broadband Classification Order*), para. 14 n. 38 ("… to the extent a service does not provide these capabilities, but merely provides transmission whether narrowband or broadband, it would not be an information service.").

transforming, processing, retrieving, utilizing, or making available information via telecommunications. However, broadband Internet access service does not itself offer end users information service capabilities, other than those fall within the telecommunications systems management exception.

US Telecom made a similar argument in *USTA v. FCC* as does the *NPRM*, namely that broadband Internet access service is an information service because it "offer[s] consumers the 'capability' to 'acquir[e]' and ;retriev[e]; information from websites, to 'stor[e]' information in the cloud, to 'transform[]' and 'process[]' information by translating plain English commands into computer protocols, to 'utiliz[e]' information through computer interaction with stored data, and to 'generat[e]' and 'mak[e] available' information to other users by sharing files."[22] The *USTelecom* court explicitly rejected this argument[23], and found that the record contains extensive evidence that broadband Internet access service is a standalone offering of transmission separate from the offering of information services that do offer such capabilities[24].

3. DNS AND CACHING PROVIDED AS PART OF BROADBAND INTERNET ACCESS SERVICE FALL WITHIN THE TELECOMMUNICATIONS SYSTEMS MANAGEMENT EXCEPTION

A. Domain name to IP address translation provided as part of broadband Internet access service falls within the telecommunications systems management exception.

The *NPRM* asks "[h]ow would broadband Internet access service work without DNS …?" and "[w]ould removing DNS have a merely incidental effect on broadband Internet users, or would it fundamentally change their online experience?".[25]

It is critical to understand the role of a broadband Internet access service provider in the DNS, and to correspondingly distinguish between (i) "removing DNS" from the entire Internet and (ii) eliminating a broadband Internet access provider's DNS server.

DNS consists of a database distributed amongst a hierarchy of DNS servers and an application that allows devices to query the distributed database.[26] Every organization with publicly accessible domain names, e.g. web servers, provides mappings between these domain names and the desired IP addresses to which traffic destined for this domain should be sent.[27] Such mappings are referred to as "authoritative resource records", meaning they are the original copy. Each such organization places these authoritative resource records into either its own DNS server or a DNS server with which the organization has contracted. In addition to the original authoritative resource record, other DNS servers may cache (i.e. temporarily store) copies of any DNS resource records it obtains through the query process described next. However, such copies are designated as "non-authoritative resource records", and must be updated based on the authoritative resource record whenever it changes.[28]

When an end user runs an application on her device, and the application wishes to convert a domain name to an IP address, the application queries the distributed DNS database.[29] The query is transmitted to a DNS server designated by the device's operating system or home router.[30] The default setting in most operating

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[22] Brief for the Petitioners, *United States Telecom Ass'n v. FCC*, 825 F.3d 674 (*USTelecom brief*) at 30.
[23] *United States Telecom Ass'n v. FCC*, 825 F.3d 674 (D.C. Cir 2016) (*USTelecom*) at 34.
[24] *USTelecom* at 38.
[25] *NPRM*, para. 37.
[26] *DNS Standard: Concept and Facilities* at 6.
[27] *DNS Standard: Concept and Facilities* at 7-15; *DNS Standard: Implementation and Specification* at 10-24.
[28] *DNS Standard: Implementation and Specification* at 3-4.
[29] *DNS Standard: Concept and Facilities* at 15-17; *DNS Standard: Implementation and Specification* at 3-7.
[30] *DNS Standard: Implementation and Specification* at 4.

systems and home routers is to use the DNS server designated by the end user's broadband Internet access service provider, which may be a DNS server operated by that broadband Internet access service provider or a DNS server operated by another entity. However, an end user may designate another DNS server of their choice by simply entering the IP address of that server into a network settings menu. Many entities offer DNS servers for this purpose.

In the unlikely case that the broadband Internet access service provider operating the default DNS server is also the organization operating the queried domain name, the DNS server responds to the query with the authoritative resource record containing the desired IP address. In the much more common case, the DNS server receiving the query does not have the original authoritative resource record.[31] In this case, the DNS server has two options. First, if it had been recently asked this same query and thus has cached the answer, it may respond with a non-authoritative copy of the desired resource record.[32] Second, it may forward the query to a sequence of unaffiliated DNS servers, ultimately receiving a copy of the authoritative resource record.

A broadband Internet access service provider's DNS server plays only a limited and replaceable role in DNS. The authoritative resource record, containing the desired mapping from domain name to IP address, originates with the organization operating that domain name.[33] A broadband Internet access service provider merely caches and forwards it.[34] Furthermore, an end user may simply designate an alternative DNS server.

With that background, I can finally respond to the *NPRM*'s questions about DNS. In response to the question about how broadband Internet access service would work "without DNS", although an end user's experience would be quite different if the Internet somehow stopped offering DNS entirely, an end user's experience would not be significantly changed if her broadband Internet access service provider does not operate its own DNS server. First, a broadband Internet access service provider may simply designate an unaffiliated entity to be the subscriber's default DNS server, in which case the end user would see no difference.[35] Second, the end user may simply designate a DNS server of her choice. If a broadband Internet access service provider neither operated its own DNS server nor designated an unaffiliated DNS server, the operating system would surely prompt the user to select one in the initial one-time set-up of the device.

This analysis is perfectly consistent with the *Cable Modem Declaratory Ruling* and with *Brand X*. The *Brand X* Court recognized that "DNS is essential to providing Internet access".[36] However, although the *Cable Modem Declaratory Ruling* represented that most cable modem service providers have DNS servers and that most include access to their DNS service as a part of cable modem service[37], it did not represent that cable modem service is not useful if DNS service is not provided by the cable modem service provider.

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[31] *DNS Standard: Concept and Facilities* at 19.
[32] *DNS Standard: Concept and Facilities* at 34.
[33] *DNS Standard: Concept and Facilities* at 7-15; *DNS Standard: Implementation and Specification* at 10-24.
[34] The secure version of DNS, called DNSSEC, authenticates that the IP address supplied by a DNS server is exactly that specified by the owner of the associated domain name. See Internet Engineering Task Force, DNS Security Introduction and Requirements, RFC 4033 (Mar. 2005), https://tools.ietf.org/html/rfc4033 (*DNSSEC*) at 7-8.
[35] Internet Engineering Task Force, Dynamic Host Configuration Protocol, RFC 2132 (Mar. 1997), https://tools.ietf.org/html/rfc2132, (*DHCP Options Standard*) at 7. In fact, per the protocol a broadband Internet access service provider need not specify a DNS server at all; see Internet Engineering Task Force, Dynamic Host Configuration Protocol, RFC 2131 (Mar. 1997), https://tools.ietf.org/html/rfc2131, (*DHCP Standard*) at 5.
[36] *Nat'l Cable & Telecomms. Ass'n v. Brand X Internet Servs.*, 545 U.S. 967 (2005) (*Brand X*) at 19.
[37] *Cable Modem Declaratory Ruling*, para. 17.

Indeed, as discussed in the DNS standard referenced in the *Cable Modem Declaratory Ruling*, a consumer may use the DNS service provided by unaffiliated entities.[38]

The *NRPM* also seeks comment on whether DNS fits within the telecommunications systems management exception.[39] The *Cable Modem Declaratory Ruling* determined that DNS is an application that offers information service capabilities, but neglected to determine whether it fell within the telecommunications systems management exception when offered by a cable modem service provider. The *Open Internet Order* conducts this analysis. It is important to distinguish between a DNS server operated by a broadband Internet access service provider and a DNS server operated by an unaffiliated entity, as they have different reasons for operating a DNS server. A broadband Internet access service provider benefits from operating its own DNS server, since this may significantly reduce the volume of DNS queries passing through its network. It is also important to distinguish between domain name to IP address translation provided by a broadband Internet access service provider's DNS server and other functions that may be provided by that DNS server. (I discuss these other options, as well as separability of broadband Internet access service from domain name to IP address translation provided by a broadband Internet access service provider's DNS server, in section 6.D.) The *Open Internet Order* correctly finds that domain name to IP address translation provided by a broadband Internet access service provider's DNS server facilitates the underlying broadband Internet access service[40] and that it does not alter the fundamental character of that service.[41] In *Computer II*, such functionality was classified as an adjunct-to-basic service, and regulated in the same fashion as was the basic service. The Order properly compares domain name to IP address translation to computer-provided directory assistance, which had been classified as an adjunct-to-basic service. Similarly, the Order correctly finds that domain name to IP address translation provided by a broadband Internet access service provider's DNS server falls within the telecommunications systems management exception.

B. Caching provided as part of broadband Internet access service falls within the telecommunications systems management exception.

The *NPRM* asks "[h]ow would broadband Internet access service work without … caching?" and "[a]bsent caching, would broadband Internet users that now expect high-quality video streaming see only incidental changes or more fundamental changes?".[42]

First, caching does not need to be a part of broadband Internet access service in order for video streaming to be high quality. Content delivery networks are a mature service, and they offer caching to edge providers to increase the quality of video streaming. Indeed, most end users today utilize video steaming services in which the only caching is that within content delivery networks.

That said, if a broadband Internet access service provider chooses to implement caching inside its network, and not as a content delivery network service offered to edge providers, then it is doing so in order to manage its broadband Internet access service. Indeed, broadband Internet access service providers

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[38] *DNS Standard: Implementation and Specification*, at 4-5. In fact, a common configuration was that each computer would act as its own DNS server, removing the need for a broadband Internet access service provider to offer a DNS server at all.
[39] *NPRM*, para. 37.
[40] *2015 Open Internet Order*, para. 368.
[41] *2015 Open Internet Order*, para. 367.
[42] *NPRM*, para. 37.

themselves routinely describe such caching practices as "network management" practices.[43] It directly follows that the practice falls within the telecommunications systems management exception.

This analysis is perfectly consistent with previous Commission proceedings. The Commission previously found that webpage caching by an Internet access service provider (dial-up, cable modem, or wireline broadband) offers an information service capability. However, none of the previous proceedings evaluated whether this capability was for the management, control, or operation of a telecommunications system or the management of a telecommunications service.

4. COMMISSION AND COURT PRECEDENT DOES NOT SUPPORT THE CLASSIFICATION OF BROADBAND INTERNET ACCESS SERVICE AS AN INFORMATION SERVICE

The *NPRM* states that "six separate Commission decisions confirm[] that Internet access service is an information service", and furthermore implies that the Internet access services defined in these six Commission decisions are all similar to today's broadband Internet access service.[44]

That implication is factually wrong. The phrase "Internet access service" is used in different proceedings to refer to different services with substantially different functionalities. In particular, none of the "Internet access services" defined in the *Stevens Repor*t, the *Cable Modem Declaratory Ruling*, and the *Wireline Broadband Classification Order* are the same as today's broadband Internet access service.

A. Internet architecture

To understand what each type of "Internet access service" offers, we need to digress and discuss Internet architecture. Section 4.A.i discusses Internet services and how they are organized. Section 4.A.ii discusses the geography of the Internet, and relates Internet services to the location of network elements.

i. Internet Services and Layers

A communications network is composed of a set of communications links and devices.[45] Each network device (e.g. a router) provides a set of *network services*.[46] The central tenet upon which the Internet is

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[43] See AT&T, "Information About the Network Practices, Performance Characteristics & Commercial Terms of AT&T's Mass Market Broadband Internet Access Services", available at https://www.att.com/gen/public-affairs?pid=20879 (accessed Aug. 16, 2017), where AT&T describes its caching practice as a "a reasonable network management video optimization technique"; Sprint, "Open Internet Information" at "Frequently Asked Questions about Network Management", available at https://www.sprint.com/legal/open_internet_information.html (accessed Aug. 16, 2017), where Sprint describes its caching practice as a "reasonable network management practice[] … consistent with mobile broadband industry standards and guidance provided by the Federal Communications Commission (FCC)"; T-Mobile, "Important Information About T-Mobile's Broadband Internet Access Services and T-Mobile's Open Internet Disclosures", available at https://www.t-mobile.com/company/company-info/consumer/internet-services.html (accessed Aug. 16, 2017), where T-Mobile describes its caching practice as a "network management practice" to "manage the flow of data on its network"; Verizon Wireless, "Explanation of Video Optimization Deployment", available at https://www.verizonwireless.com/support/video-optimization/ (accessed Aug. 16, 2017), where Verizon Wireless explains that its caching practice is a "network management technology … designed to transmit data more efficiently, ease capacity burdens on the network, primarily from video files, and improve the user experience with faster downloads and decreased Internet latency".

[44] *NPRM*, para. 38.

[45] See e.g. *Kurose* at section 1.1.2.

[46] Not all network services are offered to the public. A provider may implement network services that it only makes available to itself.

designed is that these network services are organized into *network layers*, and that the lower layer network services are *standardized*.[47]

Layering is a form of modularity. Modular architectures are a common organizing principle for building large complex systems. Modular architectures allow the designer of one module to interconnect this module with other modules by understanding only: (1) the network service provided by other modules, and (2) the messages transmitted between modules. Modular architectures free the designer of one module from the requirement to understand the way in which services provided by other modules are implemented.

Layered architectures place additional restrictions about the interconnection of various modules. First, a layered architecture imposes a vertical abstraction amongst modules. A layered architecture defines a set of layers and each module is implemented within a single layer. Second, in a layered architecture, each module may only directly communicate with the layers immediately above and below it. Thus, a module within a particular layer may offer a network service to the layer immediately above, and it may request the network services of the layer immediately below. These two restrictions (vertical abstraction and communication between modules) limit the design space, but they have proven over the history of the Internet to provide ample benefits in the design and operation of network services.

The reference model for the Internet is the Internet layer model, as pictured in Figure 1. It is useful to think of the physical connection (e.g. wire) as being located below the bottom-most layer (bit transmission), and the user (e.g. you) as being located above the top-most layer (edge provider content). In the following, I will discuss the network services offered at each network layer.

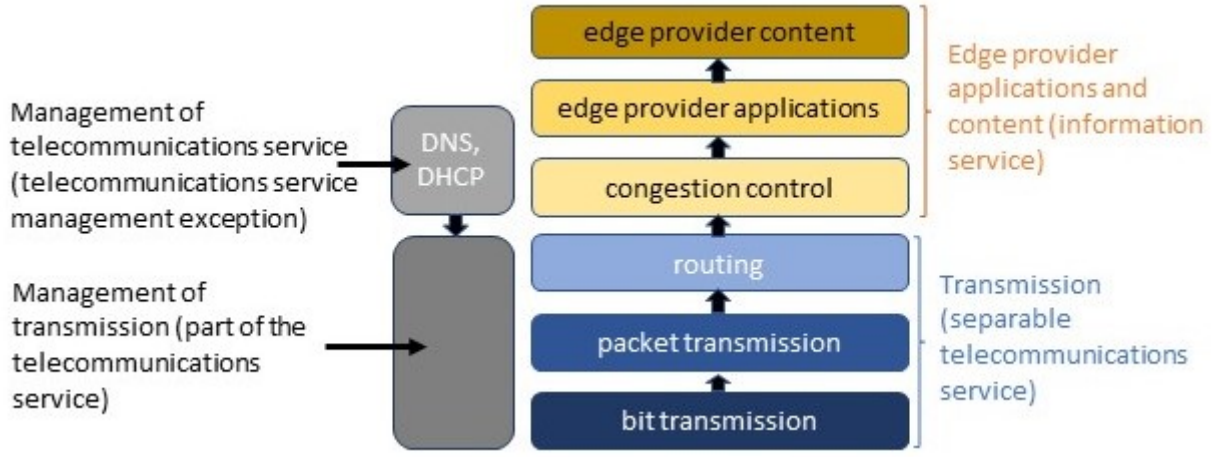

Figure 1: Internet layers.

Network service at the *physical layer* (e.g. part of Wi-Fi) is concerned with bit transmission. It offers to transmit a bit along one communications link. This network service is implemented by modules at the physical layer at each end of a communications link. The module in the device at the transmitting side of the communications link encodes each bit into a physical signal and transmits the signal onto the communications link. The module in the device at the receiving side of the communication link receives the signal from the communications link, and decodes the physical signal into a bit.

[47] Internet Engineering Task Force, Requirements for Internet Hosts – Communications Layers, RFC 1122 (Oct. 1989) (*Internet Layers Standard*), https://tools.ietf.org/html/rfc1122; *Kurose* at sections 1.1, 1.5.1.

Network service at the *data link layer* (e.g. the other part of Wi-Fi) is concerned with packet transmission. It offers to transmit packets from one device to another device on the same local area network. This network service is implemented by the combination of physical layer and data link layer modules in each device along the communications path within that local area network. The data link layer module in the source device on the local area network determines when it may access the communications link, and requests the physical layer service to transmit each bit in the packet along a communications link. The data link layer module in each hub or switch along the communications path within the local area network stores and forwards each packet, using a physical layer service to receive and transmit the physical signal. The data link layer module in the destination device on the local area network utilizes the physical layer service to receive each bit, and then combines the bits back into a packet. Prominent physical layer and data link layer services include Ethernet, Wi-Fi, DSL, DOCSIS, and 4G.

Internet service at the *network layer* (IP) is concerned with routing. The Internet Protocol (IP) service offers to transmit packets from one end of the Internet to another end of the Internet. This network service is implemented by the combination of physical layer through network layer modules in each end user device and in each router along the end-to-end communications path. The IP module in the source device determines the first router on the path, and requests the data link layer service to transmit each packet to that router. The IP module in each router on the path stores, forwards, and routes each packet, using the data link layer service to receive each packet from the previous local area network and to transmit each packet onto the next local area network. The IP module in the destination device utilizes the data link layer service to receive each packet. All communications over the Internet use the IP service.

The IP service thus provides thus provide the transmission, between or among points specified by the user, of information of the user's choosing.

Internet service at the *transport layer* (TCP) is concerned with congestion control. TCP offers to retransmit packets that did not arrive at the destination, and offers to limit when each packet is transmitted from the source to manage network congestion. Almost all communications over the Internet either use the transport layer Transmission Control Protocol (TCP) or the transport layer User Datagram Protocol (UDP).

Network services communicate via network protocols. A *network protocol* defines "the format and the order of messages exchanged between two or more communicating entities, as well as the actions taken on the transmission and/or receipt of a message or other event".[48] If a network service relies on lower layer services that use incompatible protocols, then the network service may implement protocol conversion. For instance, if the previous and next local area networks use different communication protocols, the IP service in a router converts from one protocol to another to implement its end-to-end service. Each network service may append information to a packet for the purposes of managing its service. In particular, a variety of types of addresses are often appended.[49] However, any service at the physical layer through the transport layer must remove any such appended information before the packet is given to the layer above.

Thus, from the point of view of an application, the information received from IP at the destination is the same (and is in the same form) as the information sent via IP at the source. The IP service thus provides the transmission, between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received.

Internet services at the *application layer* offer three types of network services:

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[48] *Kurose* at 9.

[49] Data link layer protocols append Medium Access Control (MAC) addresses, IP appends IP addresses, and various applications append application layer addresses (e.g. hostnames).

- Internet services that offer applications to end-users. Examples are email, web browsing, video streaming, voice calling, and video chat. These are the applications end users are familiar with.
- Internet services that offer to applications more complex services than those offered by TCP or UDP. An example is the hypertext transfer protocol (http). These are usually not directly utilized by end users, but they are utilized by applications that end users are familiar with.
- Network services that manage lower layer network services. An example is IP address assignment, typically accomplished using the DHCP protocol. These are quite different in function and purpose from applications, since they are implemented by a broadband Internet access service provider in order to manage the functionality provided by the underlying layers. As explained below, these fall within the telecommunications systems management exception.

ii. Geography of the Internet

A variety of entities operate portions of the Internet. Networks operated by various entities are interconnected to form the Internet. Both dial-up Internet access service and broadband Internet access service are provided over a communications path that often crosses networks operated by different entities.

To use *dial-up Internet access service*, the consumer purchases both local phone (telephone exchange) service and a dial-up Internet access service. The dial-up Internet access service provider operates modem banks, leases lines, provides packet switching over those leased lines, and makes interconnection arrangements to ensure the ability of subscribers to transmit data to and receive data from all Internet endpoints.[50] As pictured in Figure 2, both the end-user's computer and the edge provider's server implement all network layers. Intermediate devices – including telephone switches on the route between the customer and the modem bank, telephone switches on the leased lines, and packet switches operating over the leased lines – implement the physical through network layers to provide circuit-switched and packet-switched routing. Additional network services are provided at the transport and application layers to manage lower layer network services, e.g. translation from domain names to IP addresses.

A common communications path for dial-up Internet access service is shown in Figure 2. The Internet connection originates on a computer, passes through a communications link to a modem inside a consumer's residence, through in-home communication links to a demarcation point where the local phone service starts, through communication links operated by the local phone company to a central office, across the local phone company's network to a modem bank operated by the dial-up Internet access service provider, across phone company lines leased by the dial-up Internet access service provider, through an interconnection point to a transit provider's network, across the transit provider's network, through another interconnection point to the edge provider's network, across the edge provider's network, and to the desired edge provider's server.

[50] See e.g. *Stevens Report*, paras. 62-66.

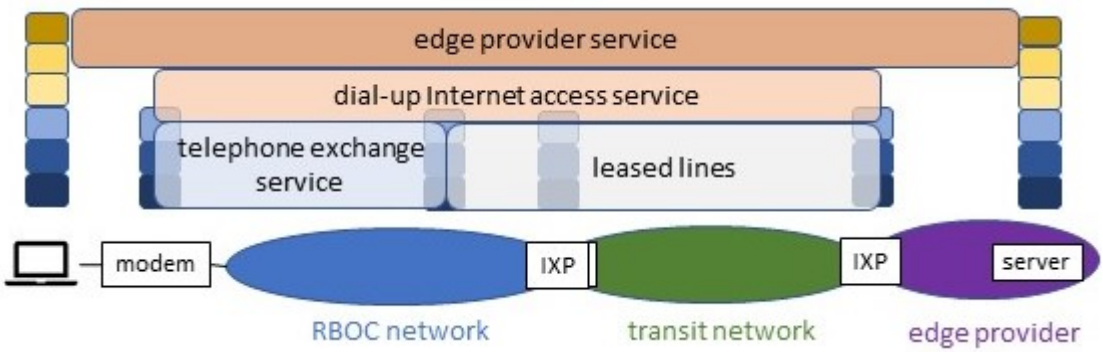

Figure 2: Dial-up Internet access service.

In contrast, to use *broadband Internet access service*, the consumer need only purchase the broadband Internet access service. The broadband Internet access service provider operates a packet-switched network, and makes interconnection arrangements to ensure the ability of subscribers to transmit data to and receive data from all Internet endpoints. As pictured in Figure 3, both the end-user's computer and the edge provider's server implement all network layers. Intermediate devices – principally routers – implement the physical through network layers to provide the IP service. Additional network services are provided at the transport and application layers to manage lower layer network services, e.g. translation from domain names to IP addresses and port blocking for network security.

A common communications paths for fixed broadband Internet access service is shown in Figure 3. The Internet connection originates on a consumer's device, passes across in-home communication links (often Wi-Fi) to a cable or DSL modem inside the consumer's residence, across the broadband Internet access service provider's network, through an interconnection point to a transit provider's network, across the transit provider's network, through another interconnection point to the edge provider's network, across the edge provider's network, and to the desired edge provider's server.[51] (For mobile broadband Internet access service, the path is similar, except that the modem is contained in the mobile device.)

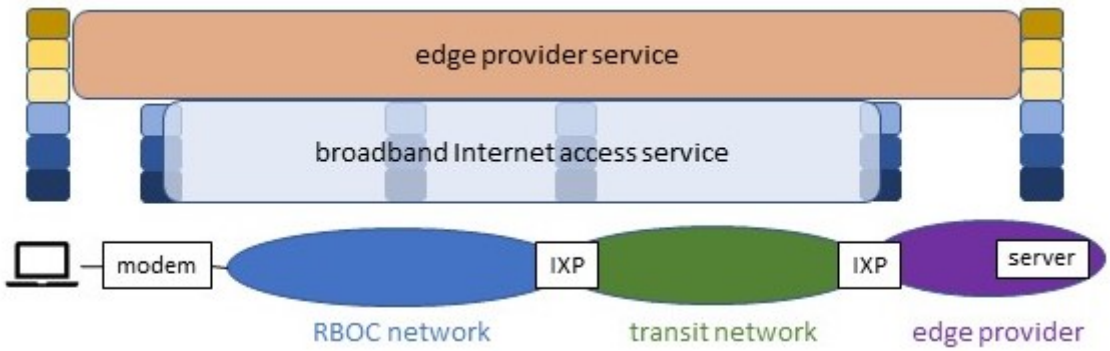

Figure 3: Broadband Internet access service.

B. Neither dial-up Internet access service, cable modem service, nor wireline broadband Internet access service are the same service as broadband Internet access service, and prior Commission

[51] There are other common situations. First, a Content Delivery Network (CDN) may replace the transit provider's network. Second, there may be an additional broadband Internet access service provider's network in the path to the edge provider.

classifications of these services do not support classification of broadband Internet access service as an information service.

The *Stevens Report* acknowledges the existence of both non-facilities-based Internet access (e.g. *dial-up Internet access service*) and facilities-based Internet access (e.g. *broadband Internet access service*). The Report, however, focuses on non-facilities-based Internet access, stating that "Internet access providers, typically, own no telecommunications facilities."[52] Broadband Internet access service was not yet mature, and although the Report briefly considered whether such services should contribute to Universal Service, it did not attempt to apply its general analysis of facilities-based information services to broadband Internet access service.[53]

Dial-up Internet access service thus excludes the underlying telecommunications, which was provided in part by the telephone exchange service that an end user separately obtained in order to "dial-up". The functionality of dial-up Internet access service consists of two parts: (a) to "enable users to access Internet content and services" [54], and (b) information service capabilities such as hosting of a subscriber's webpage, caching of webpages and newsgroup articles, and email[55].

The next type of Internet access service that the Commission considered was *xDSL-based advanced service*, which the *NPRM* neglects to mention. The *Advanced Services Order* describes xDSL-based advanced service as including: (i) the transmission of a customer's data traffic between the customer's modem and the telephone company's central office (using DSL technology)[56], (ii) the transmission between the central office and an interconnection point across the telephone company's packet switched network[57], and (iii) interconnection arrangements with other providers as necessary to fulfill the service[58]. The functionality of xDSL-based advanced service is transmission of a customer's data traffic, which is similar to the combination of the first part of the functionality of dial-up Internet access service and the local phone service used to "dial-up". However, the functionality of xDSL-based advanced service does not include the second part of the functionality of dial-up Internet access service, e.g. webpage hosting and email. The Commission classified xDSL-based advanced service as a telecommunications service.

In the *Stevens Report*, "dial-up Internet access service" consists of packet switching plus applications (including hosting of a subscriber's webpage, caching of webpages and newsgroup articles, and email). Dial-up Internet access service is offered via an underlying *telephone exchange service*. In the *Advanced Services Order*, what today we recognize as an early version of broadband Internet access service is instead termed "xDSL-based advanced service", which consists of transmission between the customer's modem and the central office and end-to-end packet switching, but excludes applications such as webpage hosting and email. To add to the confusion, the *Advanced Services Order* uses the term "Internet access service" to refer to the separable information service that offers applications (including webpage hosting and email). Thus, the phrase "Internet access" in the *Stevens Report* does not refer to the same functionalities as it does in the *Advanced Services Order*.

In the *Cable Modem Declaratory Ruling*, the Commission considers an early version of broadband facilities-based Internet access service offered by cable companies using DOCSIS and packet switching

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[52] *Stevens Report*, para. 81.
[53] *Stevens Report*, paras. 69-70.
[54] *Stevens Report*, para. 63.
[55] *Stevens Report*, para. 76.
[56] *Deployment of Wireline Services Offering Advanced Telecommunications Capability*, Memorandum Opinion and Order and Notice of Proposed Rulemaking, 13 FCC Rcd 24012 (1998) (*Advanced Services Order*), para. 29.
[57] *Advanced Services Order*, para. 31.
[58] *Advanced Services Order*, section V.A.3.

technology. The service, called *cable modem service* in the Declaratory Ruling, is defined as "a service that uses cable system facilities to provide residential subscribers with high-speed Internet access, as well as many applications or functions that can be used with high-speed Internet access."[59] In turn, "high-speed Internet access" is defined as a service that "enables consumers to communicate over the Internet at speeds that are many times faster than the speeds offered through dial-up telephone connections".[60] Finally, the Internet is defined as the global information system that -- (i) is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions/follow-ons; (ii) is able to support communications using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite or its subsequent extensions/follow-ons, and/or other IP-compatible protocols; and (iii) provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein."[61]

Putting these three definitions together, cable modem service consists of two parts: (a) a high-speed Internet access service which "enables consumers to communicate over" "the global information system that … is able to support communications … and provides, uses or makes accessible … high level services layered on the communications … infrastructure", and (b) a service that provides "many applications or functions that can be used with" the high-speed Internet access service described in part (a). The Declaratory Ruling describes part (b) of the cable modem service as including "e-mail, access to online newsgroups, and creating or obtaining and aggregating content" as well as "a 'first screen' or 'home page' and the ability to create a personal web page".[62] Part (a) of cable modem service provides similar functionality to that of xDSL-based advanced service. Part (b) of cable modem service is similar to the applications bundled in dial-up Internet access service. In contrast, xDSL-based advanced service did not include such applications; indeed, such applications were deemed in the *Advanced Services Order* to be a separable service.

Note the inconsistent meanings of "Internet access" in different proceedings. Recall that *dial-up Internet access service* consists of packet switching plus applications (including hosting of a subscriber's webpage, caching of webpages and newsgroup articles, and email), and *xDSL-based advanced service* consists of transmission between the customer's modem and the central office and end-to-end packet switching, but excludes applications (including webpage hosting and email). *Cable modem service* consists of (a) high-speed Internet access service and (b) applications that can be used with high-speed Internet access service. Part (a) of a *cable modem service* is thus similar to *xDSL-based advanced service*. It is also similar to the combination of the packet switching component of *dial-up Internet access service* and the underlying telecommunications. Part (b) of a *cable modem service* is similar to the applications component of *dial-up Internet access service*.

These different types of Internet access service are illustrated in Figure 4. The telecommunications components are shown in blue, and the information service capabilities are shown in orange.

[59] *Cable Modem Declaratory Ruling*, para 31.
[60] *Cable Modem Declaratory Ruling*, para 1 n. 1.
[61] *Cable Modem Declaratory Ruling*, para 1 n. 1.
[62] *Cable Modem Declaratory Ruling*, para. 18.

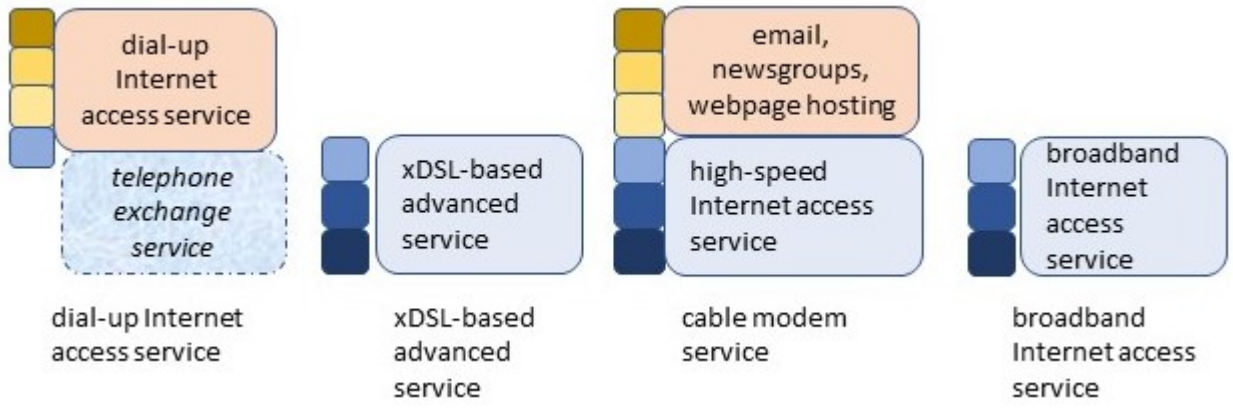

Figure 4: Different types of Internet access service.

In the *Wireline Broadband Classification Order*, the Commission reconsiders the early version of broadband facilities-based Internet access service offered by telephone companies using DSL and packet switching technology. That service had been classified as a telecommunications service in the *Advanced Services Order*. *Wireline broadband Internet access service* is defined as "a service that uses existing or future wireline facilities of the telephone network to provide subscribers with Internet access capabilities."[63] In turn, "Internet access service" is defined as "a service that always and necessarily combines computer processing, information provision, and computer interactivity with data transport, enabling end users to run a variety of applications such as e-mail, and access web pages and newsgroups."[64]

The Order does not discuss in detail the various components of *wireline broadband Internet access service.* The *Wireline Broadband Classification NPRM* describes the "data transport" component in a similar fashion to how the *Advanced Services Order* described *xDSL-based advanced service.*[65] The brief discussion of applications simply refers back to that in the *Cable Modem Declaratory Ruling*. The data transport portion of wireline broadband Internet access service provides similar functionality as xDSL-based advanced service and as the high-speed Internet access portion of cable modem service. The applications portion of wireline broadband Internet access service provides similar functionality as the corresponding portion of cable modem service. In contrast, xDSL-based advanced service did not include such applications; indeed, such applications were deemed in the *Advanced Service Order* to be a separable service.

Note yet again the inconsistent meanings of "Internet access" in different proceedings. Recall that *dial-up Internet access service* consists of packet switching plus applications, that *xDSL-based advanced service* consists of packet switching and the underlying telecommunications but excludes applications, and that *cable modem service* consists of high-speed Internet access service and applications. *Wireline broadband Internet access service* also consists of data transport (equivalent to *xDSL-based advanced service* or *high-speed Internet access service*) and applications. Thus, *wireline broadband Internet access service* is similar to the entire *cable modem service,* not to the *high-speed Internet access* component of *cable modem service*.

In the 2015 *Open Internet Order*, the Commission considers the classification of broadband Internet access service. Unlike cable modem service, wireline broadband Internet access service, or wireless broadband

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[63] *Wireline Broadband Classification Order*, para. 9.
[64] *Wireline Broadband Classification Order*, para. 9.
[65] *Appropriate Framework for Broadband Access to the Internet Over Wireline Facilities et al.*, Notice of Proposed Rulemaking, 17 FCC Rcd 3019 (2002) (*Wireline Broadband Classification NPRM*), para. 11 n. 19.

Internet access service, broadband Internet access service is technology agnostic. It includes "services provided over any technology platform, including but not limited to wire, terrestrial wireless (including fixed and mobile wireless services using licensed or unlicensed spectrum), and satellite".[66]

Broadband Internet access service is defined as "a mass-market retail service by wire or radio that provides the capability to transmit data to and receive data from all or substantially all Internet endpoints, including any capabilities that are incidental to and enable the operation of the communications service, but excluding dial-up Internet access service" and that it "encompasses any service that the Commission finds to be providing a functional equivalent of the service described".[67]

Broadband Internet access service includes applications that are offered as part of the service and that fall within the telecommunications systems management exception (management of broadband Internet access service and the management, control, or operation of the telecommunications system used to offer broadband Internet access service). Broadband Internet access service thus includes IP address assignment[68], IP address conversion[69], domain name to IP address translation provided by a broadband Internet access service provider's DNS server[70], caching by a broadband Internet access service provider[71], and security functionality that is used for the management, control, or operation of the telecommunications system[72].

Broadband Internet access service does not include applications that do not fall within the telecommunications systems management exception. Broadband Internet access service thus excludes email[73], cloud-based storage[74], spam protection[75], newsgroups[76], webpage hosting[77], customized homepages[78], firewalls[79], parental controls[80], virtual private network (VPN) services[81], content delivery networks (CDNs)[82], and hosting or data storage services[83].

Broadband Internet access service provides similar functionality as xDSL-based advanced service, as the high-speed Internet access portion of cable modem service, and as the telecommunications portion of wireline broadband Internet access service. A comparison of broadband Internet access service with cable modem service is particularly informative. Broadband Internet access service is similar to the "high-speed Internet access service" component of cable modem service, including data transmission, interconnection arrangements, and "Internet connectivity functions".[84] Applications that ride over broadband Internet

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[66] *2015 Open Internet Order*, para. 337.
[67] *2015 Open Internet Order*, para. 336.
[68] *2015 Open Internet Order*, para. 374.
[69] *2015 Open Internet Order*, para. 374.
[70] *2015 Open Internet Order*, para. 356.
[71] *2015 Open Internet Order*, para. 356.
[72] *2015 Open Internet Order*, para. 373.
[73] *2015 Open Internet Order*, para. 377.
[74] *2015 Open Internet Order*, para. 377.
[75] *2015 Open Internet Order*, para. 377.
[76] *2015 Open Internet Order*, para. 347.
[77] *2015 Open Internet Order*, para. 347.
[78] *2015 Open Internet Order*, para. 347.
[79] *2015 Open Internet Order*, para. 373.
[80] *2015 Open Internet Order*, para. 373.
[81] *2015 Open Internet Order*, para. 340.
[82] *2015 Open Internet Order*, para. 340.
[83] *2015 Open Internet Order*, para. 340.
[84] See Section 6.B.

access service are similar to the component of cable modem service described as "applications or functions that can be used with" high-speed Internet access service.

Note a final time the inconsistent meanings of "Internet access" in different proceedings. Recall that *dial-up Internet access service* consists of packet switching plus applications, that *xDSL-based advanced service* consists of packet switching and the underlying telecommunications but excludes applications, that *cable modem service* consists of high-speed Internet access service and applications, and that *wireline broadband Internet access service* also consists of data transport and applications. As illustrated in Figure 4, *broadband Internet access service* consists solely of telecommunications.

5. ALL OF THE VERSIONS OF INTERNET ACCESS SERVICE CONSIDERED BY THE COMMISSION HAVE INCLUDED INTERCONNECTION ARRANGEMENTS, AND ALL HAVE INCLUDED MORE THAN THE "LAST-MILE" CONNECTION

The *NPRM* stated that "Internet traffic exchange … is not a telecommunications service".[85] A telecommunications service is "the offering of telecommunications for a fee directly to the public …". Internet traffic exchange is not an offering directly to the public. However, that is immaterial. The 2015 *Open Internet Order* classified broadband Internet access service as a telecommunications service, and noted "the representation to retail customers that they will be able to reach 'all or substantially all Internet endpoints' necessarily includes the promise to make the interconnection arrangements necessary to allow that access".[86] The 2015 *Open Internet Order* never asserted that Internet traffic exchange is a telecommunications service.

The *NPRM* asserts that the 2015 *Open Internet Order* "deviated further from Commission precedent to extend its authority to Internet traffic exchange or 'interconnection,' an area historically unregulated and beyond the Commission's reach."[87] As explained below, all of the versions of Internet access service considered by the Commission have included interconnection arrangements.

The *NPRM* also asserts that the 2015 *Open Internet Order* "went well beyond agency precedent" by "not limit[ing] its analysis to the 'last mile' connections at issue in the *Brand X* and the FCC's underlying proceeding in that case."[88] As explained below, this assertion is factually wrong. All of the versions of Internet access service considered by the Commission have included more than the "last-mile" connection.

In the *Stevens Report*, the geographical scope of dial-up Internet access service is between a modem bank operated by the dial-up Internet access service provider and the desired edge provider.[89] The service requires the customer to obtain local phone service to provide transmission between the customer's modem and the dial-up Internet access service provider's modem bank, and requires the dial-up Internet access service provider to transport the information across its network and to make the interconnection arrangements necessary to transmit the traffic between its network and the edge providers. Thus, dial-up Internet access service included interconnection arrangements, and it included more than the "last-mile" connection.

In the *Advanced Services Order*, xDSL-based advanced service includes: (i) the transmission of a customer's data traffic between the customer's modem and the telephone company's central office (using

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[85] *NPRM*, para. 42.
[86] *2015 Open Internet Order*, para. 204.
[87] *NPRM*, para. 42.
[88] *NPRM*, para. 43.
[89] *Stevens Report*, para. 66.

DSL technology)[90], (ii) the transmission between the central office and an interconnection point across the telephone company's packet switched network[91], and (iii) interconnection arrangements with other providers as necessary to fulfill the service[92]. The *Advanced Services Remand Order* clarifies that the FCC has "consistently rejected attempts to divide communications at any intermediate points of switching or exchanges between carriers", and that xDSL-based advanced service provides transmission between the customer's modem and the other party with which the customer is communicating, e.g. a website.[93] Thus, both dial-up Internet access service and xDSL-based advanced service reach to the edge provider, but whereas dial-up Internet access service starts at the modem bank, xDSL-based advanced service starts at the customer's modem since it replaces the local phone service.

The *Cable Modem Declaratory Ruling* describes the high-speed Internet access service component of the cable modem service as including: (i) the transmission of data between a customer's modem and the cable company's headend[94], (ii) the transmission between the headend and an interconnection point across the cable company's packet switched network[95], (iii) interconnection arrangements with other providers as necessary to fulfill the service[96], and (iv) "Internet connectivity functions", including "protocol conversion, IP address number assignment, domain name resolution through a domain name system (DNS), network security, and caching"[97]. Thus, the geographical scope is between the user's modem and edge providers, similar to the geographical scope of xDSL-based advanced service. Thus, cable modem service included interconnection arrangements, and it included more than the "last-mile" connection.

In the *Wireline Broadband Classification Order,* the data transport portion of wireline broadband Internet access service provides similar functionality as xDSL-based advanced service and as the high-speed Internet access portion of cable modem service. The geographical scope of wireline broadband Internet access service are between the user's modem and edge providers, similar to the geographical scope of xDSL-based advanced service and of cable modem service. Thus, wireline broadband Internet access service included interconnection arrangements, and it included more than the "last-mile" connection.

6. BROADBAND INTERNET ACCESS SERVICE IS A SEPARABLE TELECOMMUNICATIONS SERVICE

The *NPRM* asserts that broadband Internet access service providers do not offer telecommunications because "consumers want and pay for [domain name to IP address translation and firewalls] that go beyond mere transmission—and that they have come to expect them as part and parcel of broadband Internet access service".[98] These specific functionalities were addressed in Section 1 of these comments. However, the assertion that any such functionalities are "part and parcel" of broadband Internet access service, and that this requires classification as an information service, deserve additional comment.

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[90] *Advanced Services Order*, para. 29.
[91] *Advanced Services Order*, para. 31.
[92] *Advanced Services Order*, section V.A.3.
[93] *Deployment of Wireline Services Offering Advanced Telecommunications Capability*, Order on Remand, 15 FCC Rcd 385 (1999) (*Advanced Services Remand Order*), para. 16.
[94] *Cable Modem Declaratory Ruling*, paras. 12-13.
[95] *Cable Modem Declaratory Ruling*, paras. 14-17.
[96] *Cable Modem Declaratory Ruling*, paras. 14-17.
[97] *Cable Modem Declaratory Ruling*, para. 17.
[98] *NPRM*, paras. 29-30.

A. The test is whether telecommunications is separable from information services offered via that telecommunications.

Under *Computer II*, "enhanced services are dependent upon the … offering of basic services".[99] The underlying basic service provides "a 'pure transmission' service which forms the basis upon which all 'enhanced' services are provided"[100].

At the time of *Computer II*, the Commission viewed the relationship between basic service and enhanced service using an economic input model. The basic service was an input which an enhanced services provider combined with computer processing to produce an enhanced service. Thus, the Commission considered enhanced services in which "communications and data processing technologies have become intertwined so thoroughly as to produce a form different from any explicitly recognized in the Communications Act."[101]

However, the basic service underlying enhanced services was separable from those enhanced services, and was offered separately directly to the public.

Under the *MFJ*, the relation of an information service to telecommunications mirrors that of enhanced service to the underlying basic service. In the FCC's *Computer II*, basic services "serve as the foundation for all enhanced services".[102] The *MFJ*'s definition of information service transforms the FCC's phrase "offered over common carrier transmission facilities" into "which may be conveyed via telecommunications", taking advantage of the definition of *telecommunications*, and clarifying that an information service is offered over telecommunications. Furthermore, the *MFJ Opinion* states that "[a]ll information services are provided directly via the telecommunications network".[103]

The *MFJ* prohibits RBOCs from offering information services.[104] Furthermore, whereas *Computer II* does not address enhanced capabilities offered over noncommon carrier services, the *MFJ* – by differentiating between *telecommunications* and *telecommunications service* – considers information services offered *via telecommunications* but not *via a telecommunications service*. This expansion of scope results in a prohibition on RBOCs not only from offering information services via their own telecommunications services, but also from offering information services via other telecommunications.

Thus, the telecommunications service offered by an RBOC was separable from enhanced services offered via it, and was offered separately to the public.

Under the *1996 Act*, the relation of an information service to telecommunications remains as it was under the *MFJ*, and similar to the relation of enhanced service to basic service. Whereas in the *MFJ*, an information service "may [be] conveyed via telecommunications", in the *1996 Act* an information service must now be an offering "via telecommunications". As in the *MFJ*, the use of telecommunications is not restricted to voice applications. Finally, as in the *MFJ*, an information service may be offered either via a telecommunications service or via private telecommunications.[105]

In *Brand X*, the Court notes that the term "offering" in the definition of telecommunications service is ambiguous, and grants Chevron deference to the Commission to interpret it for this purpose.[106] The Court

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[99] *Computer II*, para. 231.
[100] *Computer II*, para 90.
[101] *Computer II*, para. 120.
[102] *Computer II*, para. 116.
[103] *United States v. Am. Tel. & Tel. Co.*, 552 F. Supp. 131 (D.D.C. 1982) (*MFJ*) at 189.
[104] *MFJ* at 227. This prohibition was removed in 1991 by the D.C. District Court.
[105] S. Rep. No. 104-230 (1996) (*1996 Act Conference Report*) at 115.
[106] *Brand X* at 18.

accepts as a reasonable interpretation that the determination of whether cable modem service includes an offering of telecommunications turns on "the nature of the functions the end user is offered"[107], and that common usage of the word "offer" is that what a company offers is what "the consumer perceives to be the integrated finished product".[108] The Court thus states that "[t]he question, then is whether the transmission component of cable modem service is sufficiently integrated with the finished service to make it reasonable to describe the two as a single, integrated offering".[109] It further states that "[t]he entire question is whether the products here are functionally integrated (like the components of a car) or functionally separate (like pets and leashes)" and "[t]hat question turns not on the language of the Act, but on the factual particulars of how Internet technology works and how it is provided".[110]

Thus, the test is whether telecommunications is separable from information services offered via it. The underlying telecommunications is not deemed to be inseparable merely because the provider of that service chooses not to offer it. Indeed, the *Brand X* Court did not understand the Commission as saying that "any telecommunications service that is priced or bundled with an information service is automatically unregulated under Title II".[111]

B. The central tenet of Internet architecture dictates that telecommunications service is separable from information services.

Both *Computer II* and the *MFJ* had envisioned that information services would be offered using an economic input model – namely, that the information service provider would procure telecommunications, combine it with computer processing, and sell the resulting information service to the consumer. Furthermore, both *Computer II* and the *MFJ* had envisioned that the information service functionality (e.g. data processing) may be intertwined with the underlying telecommunications to the extent that an information service no longer transmits intelligence of a customer's own design and choosing, and thus is no longer telecommunications.

Both assumptions – that telecommunications is an economic input to an information service, and that information service functionality is intertwined with the underlying telecommunications – were appropriate at the time. The distributed computing applications that served as the inspiration for information services were at that time provisioned using telecommunications as an input. Furthermore, applications offered over the PSTN often intertwined communications with data processing.

However, both assumptions fail in the Internet. The central tenet upon which the Internet is designed is that network services are organized into *network layers*, and that the lower layer network services are *standardized*.[112] This principle is so fundamental that it is the topic of one of three foundational Internet standards laying out the Internet's architecture, and it is taught in the first chapter of almost all textbooks on Internet architecture.

The Internet Engineering Task Force (IETF) develops Internet standards, including the Internet Protocol (IP) used by all Internet communications and the Transmission Control Protocol (TCP). These protocols have standardized functions, and standardized interfaces to other protocols. Standardized software interfaces are the software equivalent of the standardized modular telephone plugs we are all familiar with. They make possible interoperability of devices and software designed by different entities.

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[107] *Brand X* at 16, quoting *Cable Modem Declaratory Ruling* at 38.
[108] *Brand X* at 18.
[109] *Brand X* at 18.
[110] *Brand X* at 19-20.
[111] *Brand X* at 26.
[112] *Internet Layers Standard*; *Kurose* at sections 1.1, 1.5.1.

Modularity and standardization of interfaces is exactly what makes the Internet possible. One result of modularity and standardization of interfaces is that edge providers can design applications without the need for coordination with or permission from broadband Internet access service providers who offer the lower layer IP packet transfer service. Another result of modularity and standardization of interfaces is that device manufacturers can design Internet-connected devices without the need for coordination with or permission from broadband Internet access service providers.

Without modularity and standardization of interfaces, the incredibly wide variety of Internet-connected devices and Internet applications would not be possible. The modularity of network services guarantees that different entities can provide different network services, and that these network services can interoperate with other.

In order to use dial-up Internet access service, a consumer must purchase both a local phone service and a dial-up Internet access service. Modularity and standardization of interfaces guarantees that the two services can be provided by different entities.

Similarly, in order to use email, a consumer must both purchase Internet access service and obtain access to an email service. Modularity and standardization of interfaces again guarantees that the two services can be provided by different entities.

The Internet's architecture guarantees that the IP packet transfer service, which provides end-to-transmission of information of the user's choosing, is separable from the applications (such as webpage hosting, caching of newsgroup articles, and email) riding over it. Protocols at the physical, data link, and network layers are designed separately from Internet applications. The Internet Protocol that transmits packets from one end of the Internet to another end is standardized, and is independent of all of the Internet applications that are offered via it. Protocols at the physical, data link, and network layers are implemented in the operating systems of end user devices, and are not in any way integrated in those operating systems with Internet applications. The result is that Internet applications may be offered by entities other than broadband Internet access service providers.

It is also important to recognize that the relationship between network services is not symmetric. In a layered architecture, a module at one layer may request a network service provided by a lower layer. Although it may pass information to a higher layer, it may not request a network service from a higher layer. Thus, while a service at one layer may rely on the network services provided by lower layers, it may not rely on network service provided by higher layers. For instance, while an email application (at the application layer) clearly relies on lower layer services such as the IP packet transfer service to transmit and route the packets that comprise a piece of email, the IP packet transfer service that transmits and routes packets from one end of the Internet to another does not rely on application layer services such as email. Thus, an email service is useless without Internet access service. However, an Internet access service is useful without an email service. This lack of symmetry is fundamental to Internet design, and to the separability of telecommunications service from information services.

C. Broadband Internet access service is separable from bundled applications.

It is a direct and inescapable consequence of Internet architecture that broadband Internet access service is separable from bundled applications such as webpage hosting, caching of newsgroup articles, and email.

Broadband Internet access service is defined as "a mass-market retail service by wire or radio that provides the capability to transmit data to and receive data from all or substantially all Internet endpoints, including any capabilities that are incidental to and enable the operation of the communications service, but excluding

dial-up Internet access service" and that it "encompasses any service that the Commission finds to be providing a functional equivalent of the service described".[113]

Broadband Internet access service does not include applications that do not fall within the telecommunications systems management exception. Broadband Internet access service thus excludes email[114], cloud-based storage[115], spam protection[116], newsgroups[117], webpage hosting[118], customized homepages[119], firewalls[120], parental controls[121], virtual private network (VPN) services[122], content delivery networks (CDNs)[123], and hosting or data storage services[124].

The core component of broadband Internet access service is the capability to transmit data to and receive data from all or substantially all Internet endpoints, namely the end-to-end transmission of information of the user's choosing. This function is provided by the IP packet transfer service offered by a broadband Internet access service provider. As discussed above, this IP service is separable from all Internet applications, and thus from any bundled Internet applications such as webpage hosting, caching of newsgroup articles, and email. This follows, as the *Brand X* Court said, from "the factual particulars of how Internet technology works and how it is provided".

Broadband Internet access service also includes applications that are offered as part of the service and that fall within the telecommunications systems management exception (management of broadband Internet access service and the management, control, or operation of the telecommunications system used to offer broadband Internet access service). Broadband Internet access service thus includes IP address assignment[125], IP address conversion[126], domain name to IP address translation provided by a broadband Internet access service provider's DNS server[127], caching by a broadband Internet access service provider[128], and security functionality that is used for the management, control, or operation of the telecommunications system[129]. All of these applications that fall within the telecommunications system management exception are also separable from all other Internet applications, and thus from any bundled Internet applications such as webpage hosting, caching of newsgroup articles, and email.

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[113] *2015 Open Internet Order*, para. 336.
[114] *2015 Open Internet Order*, para. 377.
[115] *2015 Open Internet Order*, para. 377.
[116] *2015 Open Internet Order*, para. 377.
[117] *2015 Open Internet Order*, para. 347.
[118] *2015 Open Internet Order*, para. 347.
[119] *2015 Open Internet Order*, para. 347.
[120] *2015 Open Internet Order*, para. 373.
[121] *2015 Open Internet Order*, para. 373.
[122] *2015 Open Internet Order*, para. 340.
[123] *2015 Open Internet Order*, para. 340.
[124] *2015 Open Internet Order*, para. 340.
[125] *2015 Open Internet Order*, para. 374.
[126] *2015 Open Internet Order*, para. 374.
[127] *2015 Open Internet Order*, para. 356.
[128] *2015 Open Internet Order*, para. 356.
[129] *2015 Open Internet Order*, para. 373.

D. Broadband Internet access service is separable from a broadband Internet access service provider's DNS service.

In Section 3.A, I explained in detail why the *Open Internet Order* correctly finds that domain name to IP address translation provided by a broadband Internet access service provider's DNS server falls within the telecommunications systems management exception.

The *Open Internet Order* also correctly notes that a broadband Internet access service provider's DNS server may offer other functionalities that do not fall within the telecommunications systems management exception, e.g. IP address to domain name translation ("reverse look-up"). It finds that such functionality is separable, because broadband Internet access service does not in any way depend on such functionality.[130] It may be provided by a broadband Internet access service provider's DNS server, by an unaffiliated DNS server, or not at all.[131] The separability again follows from both the modularity of Internet architecture[132] and the Internet standards for DNS[133]. Separability is also evidenced by the offerings of DNS servers from entities unaffiliated with the broadband Internet access service provider.[134]

E. Broadband Internet access service is separable from bundled security applications that do not fall within the telecommunications systems management exception.

In Section 1.B.i, I explained that it is important to distinguish between (i) security functions that a broadband Internet access service provider implements for the management of the broadband Internet access service or the management, control, or operation of the telecommunications system used to provision broadband Internet access service, and (ii) the security functions that a broadband Internet access service provider offers to end users by bunding security software with its broadband Internet access service. In the former case, e.g. blocking denial of service attacks, the security function falls within the telecommunications systems management exception.

In the latter case, e.g. virus and/or firewall software bundled with broadband Internet access service, such an application is not part of the broadband Internet access service.[135] Furthermore, these applications are just like the other bundled applications considered in Section 6.C. It follows as a direct and inescapable consequence of Internet architecture that broadband Internet access service is separable from such bundled applications.

7. MOBILE BROADBAND INTERNET ACCESS SERVICE IS A COMMERCIAL MOBILE RADIO SERVICE

Whether mobile broadband Internet access service is a commercial mobile radio service depends on whether it is an *interconnected service*, which in turn depends on whether it is *interconnected* with the *public switched network*. Section 7.A analyzes the public switched network, and the section 7.B analyzes interconnected service.

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[130] *2015 Open Internet Order*, para. 369.
[131] *DNS Standard: Concept and Facilities* at 18; *DNS Standard: Implementation and Specification* at 40.
[132] *2015 Open Internet Order*, para. 378.
[133] *DNS Standard: Implementation and Specification*, at 4-5.
[134] *2015 Open Internet Order*, para. 370. Similarly, even if domain name to IP address translation provided by a broadband Internet access service provider's DNS server did not fall within the telecommunications systems management exception, that function would also be separable from the underlying telecommunications.
[135] *2015 Open Internet Order*, para. 373.

A. There is a single public switched network that includes the networks used to provision telephone exchange service, telephone toll service, mobile service, and broadband Internet access service.

The public switched network is a *common carrier switched network* that uses particular addressing plans in connection with the provision of *switched services*. Before analyzing the public switched network, it is worthwhile to discuss the meaning of *switched services*.

i. Telephone exchange service, telephone toll service, mobile service, and broadband Internet access service are switched services, and the networks used to provision them are common carrier switched networks.

In electrical engineering and computer science, there is a critical distinction between network elements, functions provided by network elements, and services composed of such functions. As discussed in section 4.A.i, a *communications network* is composed of a set of communications links and devices.[136] Each network device (e.g. a router) provides a set of *network services*.[137] By combining such network services, a telecommunications services provider may offer *telecommunications*. The communications network is used to provision a network service; the network is not itself the service.

In networking, *switching* refers to the function that interconnects network elements, a *switch* refers to the module (e.g. routing) or device (e.g. a router) that performs switching, and a *switched service* correspondingly refers to a service that offers transmission between multiple parties.

Circuit-switching and *packet-switching* are common families of technologies used in the provision of switched services. However, they are only a means to an end. A service provider may choose among several competing technologies to provision a service. For instance, voice service may be provided using a circuit-switched network, using a packet-switched network combined with a "virtual circuit" protocol that mimics a circuit (e.g. using the MPLS protocol or using a Virtual Private Network), using a packet-switched network combined with software that mimics a circuit (e.g. most VoIP software), or using any combination of these technologies.

Under the *Communications Act* and a long string of Commission Orders, there is a similar distinction between the communications network used to provision a telecommunications service and the telecommunications service itself. The communications network is used to provision a telecommunications service; the network is not itself the telecommunications service.

There is no doubt that telephone exchange service, telephone toll service, and mobile service are switched services. All of these services provide telecommunications, namely the transmission, between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received. All of these services are telecommunications services, namely the offering of telecommunications for a fee directly to the public, or to such classes of users as to be effectively available directly to the public, regardless of the facilities used. All of these services are switched services, namely services that offers transmission between multiple parties by interconnecting (i.e. switching) these parties.

It is irrelevant whether telephone exchange service, telephone toll service, or mobile service are provided using a circuit-switched network, using a packet-switched network combined with a "virtual circuit" protocol that mimics a circuit (e.g. using the MPLS protocol or using a Virtual Private Network), using a packet-switched network combined with software that mimics a circuit (e.g. most VoIP software), or using

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[136] See e.g. *Kurose* at section 1.1.2.

[137] Not all network services are offered to the public. A provider may implement network services that it only makes available to itself.

any combination of these technologies. Indeed, these service providers use a wide variety of such technologies to offer these services. Mobile voice providers are currently in the process of converting the wireless transmission protocol underlying mobile service from a circuit-switched technology (used in 3G) to a packet-switched technology (used in 5G). Even the Commission's 1994 *Second CMRS Report and Order* explicitly incorporated store and forward technology in the definition of "interconnected".[138] Store and forward technology is the cornerstone of packet switching.

Similarly, there is no doubt that broadband Internet access service is a switched service. As discussed in previous sections, broadband Internet access service provides telecommunications, and it is a telecommunications service. In addition, it is a switched service, namely a service that enables communication between multiple parties by interconnecting (i.e. switching) these parties. The underlying technology is again irrelevant. Broadband Internet access service may be provisioned solely using packet-switching or using a combination of circuit-switching and packet-switching.

The *Communications Act* does not define the term "common carrier switched network". Presumably, it is a switched network operated by a common carrier. The Commission's definition of *public switched network* includes the networks of local exchange carriers, interexchange carriers, and mobile service providers that are used in the provision of switched services. There is thus no doubt that the networks used to provision telephone exchange service, telephone toll service, and mobile service are common carrier switched networks. As argued above, broadband Internet access service is a telecommunications service, and thus the networks used to provision broadband Internet access service are also common carrier switched networks.

ii. The public switched network includes the networks used to provision telephone exchange service, telephone toll service, mobile service, and broadband Internet access service.

In the 1994 *Second CMRS Report and Order*, the *public switched network* was defined by the Commission as "[a]ny common carrier switched network, whether by wire or radio, including local exchange carriers, interexchange carriers, and mobile service providers, that use[s] the North American Numbering Plan in connection with the provision of switched services."[139] The *2015 Open Internet Order* updated the definition to "the network that includes any common carrier switched network, whether by wire or radio, including local exchange carriers, interexchange carriers, and mobile service providers, that use[s] the North American Numbering Plan, or public IP addresses, in connection with the provision of switched services"[140] to reflect the emergence and growth of public networks using IP addresses.[141]

The *NPRM* proposes to regress to the earlier outdated definition.[142] It gives two rationales for this regression. First, the *NPRM* "find[s] persuasive the Commission's reasoning when originally adopting the prior definition, which also appears more consistent with the historical usage of the term 'public switched network'".[143]

However, the Commission's reasoning when adopting the prior definition leads to the opposite conclusion. In that Order, the Commission rejected the view that the term *public switched network* should be based on a specific technology, and thus explicitly rejected equating it with the "more technologically based term

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[138] *Implementation of Sections 3(n) and 332 of the Communications Act; Regulatory Treatment of Mobile Services*, Second Report and Order, 9 FCC Rcd 1411 (1994) (*Second CMRS Report and Order*), para 57.
[139] *Second CMRS Report and Order*, Appendix A: Final Rules, section 20.3.
[140] 47 CFR § 20.3.
[141] *2015 Open Internet Order*, para. 391.
[142] *NPRM*, para. 56.
[143] *NPRM*, para. 56.

'public switched telephone network'"[144]. The Commission explicitly rejected interpreting the term *public switched network* "in a static way", and stated that "[t]he network is continuously growing and changing because of new technology and increasing demand".[145] Instead, the Order declared that "[t]he purpose of the public switched network is to allow the public to send or receive messages to or from anywhere in the nation."[146] For that reason, the Order expanded the definition of *public switched network* from *public switched telephone network* (which had referred to "the local exchange and interexchange common carrier switched network[s]") to a definition that also incorporated the common carrier switched networks used in the provision of mobile services.[147]

Today, the "public switched network [that] allow[s] the public to send or receive messages to or from anywhere in the nation"[148] includes common carrier switched networks that use public IP addresses in connection the provision of broadband Internet access service.[149]

iii. There is a single public switched network, regardless of whether the Commission reverts to the outdated definition.

The second rationale the *NPRM* gives for regressing to the outdated definition of *public switched network* is the claim that the old definition "appears to better accord with the text of section 332(d)(2) by clearly covering only a single, integrated network, and was not disturbed by Congress in amendments to section 332 of the Act."[150] This claim is factually wrong.

Common carrier switched networks are connected to form larger communications networks, such as the public switched network. The networks used to provision telephone exchange service and telephone toll service were connected to form a larger communications network. Later, the networks used to provision paging service were connected to those earlier networks to form yet a larger communications network. Later yet, the networks used to provision mobile service were connected to these earlier networks to form an even larger communications network. Today, the networks used to provision broadband Internet access service are connected to all of these other networks to form the public switched network. The resulting public switched network is a single network that includes the networks used to provision telephone exchange service, telephone toll service, mobile service, and broadband Internet access service.

The public switched network is a single network ("*the* public switched network"). First, it is a physically connected network. All of the network elements are connected. The PSTN and the Internet are not two physically separate networks. They share network elements, including access networks. To the degree to which they have dedicated network elements, the dedicated PSTN elements are connected to the dedicated Internet elements via other network elements.

Second, the public switched network is used to provision common carrier switched services that offer transmission between multiple parties. Furthermore, as explained below, any pair of end user users may communicate, providing that they have obtained the necessary services and the necessary hardware and/or software.

The public switched network is thus already a single network. No regression to the outdated definition of *public switched network* is necessary to make it a single network. Furthermore, and more critically, even

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[144] *Second CMRS Report and Order*, para 59.
[145] *Second CMRS Report and Order*, para 59.
[146] *Second CMRS Report and Order*, para 59.
[147] *Second CMRS Report and Order*, para 59.
[148] *Second CMRS Report and Order*, para 59.
[149] *2015 Open Internet Order*, para. 391.
[150] *NPRM*, para. 56.

such a regression would not remove the networks used to provision broadband Internet access service from being a part of the single network.

1. The existence of a single network rests on the characteristics of the network, not on the services provisioned over the network.

It is important to correct several misconceptions in the record. One misconception is that whether there is a single public switched network depends on the services provisioned over the network(s). However, the public switched network is *not* defined by the switched service provisioned over it. As discussed above, a communications network is not itself a telecommunications service, but rather it is used to provision a telecommunications service. The PSTN is not telephone exchange service or telephone toll service. These services are provisioned over parts of the PSTN, but they are not the PSTN. Indeed, the Communications Act explains that "'[t]elecommunications equipment' means equipment, other than customer premises equipment, used by a carrier to provide telecommunications services, and includes software integral to such equipment".[151] Under the Act, telecommunications equipment is used to provide telecommunications service.

The same communications network may be used to provision multiple telecommunications services, as well as other services. The public switched network is *not* the set of networks that use the North American Numbering Plan (NANP) in connection with the provision of telephone exchange service, nor telephone toll service, nor mobile service. The public switched network is the network that includes any common carrier switched network that uses the North American Numbering Plan, or public IP addresses, in connection with the provision of switched services. Multiple switched services are provisioned over the same public switched network. The existence of a single network rests on the characteristics of the network, not on the services provisioned over the network.

2. A single network does not necessitate that all devices utilize a uniform addressing space.

Another misconception is that whether there is a single public switched network depends on whether all end users can be reached using a single addressing space (e.g. NANP). However, networks using different addressing spaces can be connected to form a larger single network.

A *network address* is an identifier of a device (or a network interface on a device) used by a communication protocol to communicate with other devices running that protocol. A *network address space* is the set of potential network addresses of devices using a particular format of network address. Network address spaces can be *public* or *private*. A network address space is public if the space is partitioned among multiple organizations, and is private otherwise. The set of North American Numbering Plan (NANP) telephone numbers is a public address space. The set of public IP addresses is a public address space.[152] There are also multiple network address spaces used by Media Access Control (MAC) protocols, e.g. DOSCIS, LTE, and various paging protocols.

The purpose of network addresses is to enable routing among connected communications networks. However, different communications networks use different communications protocols, and each communication protocol typically defines its own address space. For instance, the PSTN uses NANP addresses in the wireline portion of the PSTN, paging MAC addresses in paging networks, and a variety of formats of cell phone MAC addresses in cell phone networks. In addition, a device often implements several

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[151] 47 U.S.C. § 153(45).

[152] See *2015 Open Internet Order*, para. 391 n. 1115 (defining "public IP addresses" for the purpose of the regulatory definition of PSN as "globally routable unicast IP addresses").

communications protocols, and hence is often assigned multiple network addresses. For instance, a mobile smartphone will often be assigned a NANP address, a private IP address, and an LTE MAC address.

The variety of network addresses does not, however, fragment the public switched network. Use of a combination of network addresses enables routing of messages through different part of the public switched network. When a page is sent, the telephone number of the pager is translated into the pager's MAC address so that the paging message may be routed from the wireline portion of the PSTN onto a paging network. Similarly, when a call is placed to a mobile phone, the telephone number of the mobile phone is translated into the mobile phone's MAC address so that the call may be routed from the wireline portion of the PSTN onto the cell phone network.

The same is true in the Internet. Mobile broadband Internet access service providers often assign private IP addresses to mobile devices including smartphones. The private IP address only identifies the device *within* the mobile broadband Internet access provider's network. In order for the mobile device to transmit messages to and from devices outside that provider's network, that private IP address must be combined with the public IP address of the broadband provider (and with an additional type of address called a *network port*). A device thus need not be assigned a public network address to be reachable on the public network.

It follows, as a direct consequence of network architecture, that a single public switched network does not require that all devices on the network utilize a uniform addressing space (e.g. NANP). Networks using different addressing spaces are connected to form a larger single network.

3. A single network does not necessitate that all users of the network may communicate with all other users.

Neither the Commission's current definition of *public switched network* nor its old definition includes a requirement that all users of the network be able to communicate with all other users. As discussed below, the ability to communicate depends on the services subscribed to and on the functionality of end user devices.

The issue of who may communicate with whom over the public switched network arises not in the question of whether there is a single public switched network, but in the question of whether a particular service is an interconnected service. We now turn to that question.

B. Mobile broadband Internet access service is an interconnected service.

In the 1994 *Second CMRS Report and Order*, an *interconnected service* was defined by the Commission as a "service that is interconnected with the public switched network, or interconnected with the public switched network through an interconnected service provider, that gives subscribers the capability to communicate to or receive communication from all other users on the public switched network …"[153] The *2015 Open Internet Order* removed the word "all" from the definition[154] to clarify that a service is interconnected even if it is made available only to a substantial portion of the public.[155] Furthermore, the 1994 *Second CMRS Report and Order* defined *interconnected* as "direct or indirect connection through automatic or manual means (by wire, microwave, or other technologies such as store and forward) to permit the transmission or reception of messages or signals to or from points in the public switched network."[156] That definition was unchanged by the *2015 Open Internet Order*.

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[153] *Second CMRS Report and Order*, Appendix A: Final Rules, section 20.3.
[154] 47 CFR § 20.3.
[155] *2015 Open Internet Order*, para. 402 n. 1175.
[156] *Second CMRS Report and Order*, Appendix A: Final Rules, section 20.3.

The *NPRM* proposes to regress to the earlier definition of *interconnected service*.[157] The rationale given for this regression is that the removal of the word "all" "appears to run contrary to the focus on a single, integrated network that we believe Congress likely intended in section 332(d)(2)."[158] However, as explained below, regardless of whether the word "all" remains in the definition, mobile broadband Internet access service is an interconnected service.

i. A telecommunications service offers transmission between points specified by the user, but in order to meaningfully communicate end users must acquire the necessary services and CPE.

Before analyzing interconnection of mobile broadband Internet access service with the public switched network, it is worthwhile to be precise about the meaning of the phrase "that gives subscribers the capability to communicate to or receive communication from all other users on the public switched network".

A telecommunications service does not by itself offer subscribers the ability to meaningfully communicate. A telecommunications service is the offering of telecommunications. Telecommunications is the transmission, between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received. However, in order for end users to meaningfully communicate, they must (i) obtain the services that entitle them to transmit information between each other, and (ii) obtain CPE sufficient to address messages to each other and to encode and decode these messages.

The requirement to acquire the necessary services in order to engage in meaningful communication is as old as communication networks are. For example, meaningful voice communication between two parties in different telephone exchanges requires that both parties have subscribed to telephone exchange service and that the calling party has subscribed to telephone toll service. Similarly, successful transmission of a paging message requires that the source has subscribed to telephone exchange service and that the destination has subscribed to paging service.

The requirement to acquire the necessary to engage in meaningful communication is also as old as communication networks are. For example, meaningful voice communication between two parties requires that each party has CPE capable of establishing connections, allowing for entry and transmission of the called party's telephone number, encoding voice into a transmittable signal, and decoding a received signal into voice. Without the capability of transmitting the called party's telephone number, one can't actually engage the telephone exchange service. Without the capability of encoding voice into a transmittable signal, one can't transmit anything. Without the capability of decoding a received signal into voice, the received signal can't be heard. As another example, successful transmission of a paging message requires that the source party has a device capable of transmitting a paging message (e.g. a wireline or mobile phone) and that the destination party has a device capable of receiving a paging message (e.g. a pager). As yet another example, successful transmission of a fax requires that that the source party has a device capable of transmitting a fax (e.g. a fax machine) and that the destination party has a device capable of receiving a fax (e.g. a fax machine).

The necessary CPE always includes hardware, namely the device. Today, almost all CPE also includes software, namely the application an end user is running on the device. Whereas once upon a time CPE for voice communication consisted of devices dedicated exclusively to that application, today one may use a voice app on a smartphone, a tablet, or a PC. The CPE necessary for meaningful communication has thus become the combination of hardware and/or software that includes functionality to generate and/or process content, to address communicating parties, and to set up and maintain connections with communicating

[157] *NPRM*, para. 57.
[158] *NPRM*, para. 57.

parties. For example, email communication between two parties requires that each party run an email application (whether standalone or through a webpage), instant messaging between two parties requires that each party run an interoperable instant messaging application, video chat between two parties requires that each party run a compatible video chat application, and web browsing requires the web browser and the webserver to both implement the http protocol.

ii. An interconnected service does not provide subscribers the ability to meaningfully communicate with all other users on the public switched network, absent the necessary telecommunication services and CPE.

Because meaningful communication has always required end users to acquire the necessary telecommunication services and CPE, and because mobile service is an interconnected service, it follows as a direct consequence that an interconnected service does not provide subscribers the ability to meaningfully communicate with all other users on the public switched network absent the necessary telecommunication services and CPE.

First, an interconnected service does not by itself provide subscribers the ability to meaningfully communicate with all other users on the public switched network absent the necessary telecommunication services. Two subscribers to telephone exchange service that reside in different telephone exchanges cannot call each other, and yet it would be nonsensical to say that telephone exchange service is not an interconnected service. Subscription to an interconnected service does not guarantee an end user that he will be able to communicate with *every other service* operated over the public switched network. Given that end users subscribe to a variety of interconnected services, subscription to an interconnected service does not guarantee an end user that she will be able to communicate with *all other subscribers of all services* operated over the public switched network. The ability of a pair of end users to communicate depends on the telecommunication services to which they have subscribed.

Second, an interconnected service does not by itself provide subscribers the ability to meaningfully communicate with all other users on the public switched network absent the necessary CPE. For example, a subscriber to mobile service cannot engage in meaningful communication with a fax machine on the public switched network (without utilizing a fax app). As another example, a subscriber to a one-way paging service may not transmit messages to or from another subscriber to a one-way paging service. The ability of a pair of end users to meaningfully communicate depends on CPE they are using.

iii. Mobile broadband Internet access service is an interconnected service, because it is interconnected with the public switched network and it gives subscribers the capability to communicate to or receive communication from all other users on the public switched network, providing that the parties have acquired the necessary telecommunication services and CPE.

A service is an interconnected service if it is interconnected with the public switched network and it gives subscribers the capability to communicate to or receive communications from other users on the public switched network, providing that the parties have acquired the necessary telecommunication services and CPE.

Under the current definitions of *public switched network* and *interconnected service*, there is no doubt that mobile broadband Internet access service is an interconnected service. The definition of *interconnected* is "direct or indirect connection through automatic or manual means (by wire, microwave, or other technologies such as store and forward) to permit the transmission or reception of messages or signals to or from points in the public switched network."[159] Mobile broadband Internet access service is connection

[159] *Second CMRS Report and Order*, Appendix A: Final Rules, section 20.3.

through technologies such as store and forward that permits the transmission and reception of messages to and from points in the public switched network. Without doubt, these points include (but are not limited to) the devices of other subscribers to broadband Internet access service, since by definition broadband Internet access service provides the capability to transmit data to and receive data from all or substantially all Internet endpoints. It similarly follows that mobile broadband Internet access service gives subscribers the capability to communicate to or receive communications from other users on the public switched network. These users include (but are not limited to) those who are subscribers to broadband Internet access service and are using devices capable of using that service.[160]

1. This conclusion remains true if the Commission regresses to the old definition of interconnected service.

If the Commission regresses to the old definition of *interconnected service*, then a service is an interconnected service if it is interconnected with the public switched network and it gives subscribers the capability to communicate to or receive communications from *all* other users on the public switched network, providing that the parties have acquired the necessary telecommunication services and CPE.

In that case, mobile broadband Internet access service is still an interconnected service. As above, mobile broadband Internet access service is *interconnected* with the public switched network, because it is connection through technologies such as store and forward that permits the transmission and reception of messages to and from points in the public switched network. As before, without doubt these points include (but are not limited to) the devices of other subscribers to broadband Internet access service.

Mobile broadband Internet access service also gives subscribers the capability to communicate to or receive communications from *all* other users on the public switched network, providing that the parties have acquired the necessary telecommunication services and CPE. An end user who has subscribed to mobile broadband Internet access service clearly has the capability to communicate to and receive communications from all other users who are subscribers to broadband Internet access service and are using devices capable of using that service.[161]

In addition, an end user who has subscribed to mobile broadband Internet access service also has the capability to communicate to and receive communications from all other users who are subscribers to other interconnected services (e.g. telephone exchange service, telephone toll service, and mobile service), providing that the parties have acquired the necessary services and CPE. There are many options for doing so. First, the mobile Internet access service subscriber may simply obtain and utilize an app that is capable of address communicating parties and of setting up and maintaining connections with communicating parties.[162] Several such apps are available today, including Skype, Google Voice, Cisco WebEx, and GoToMeeting. Second, the party with which the mobile Internet access service subscriber wishes to communicate may obtain and utilize a voice forwarding service, such as an email-to-voice service. In either case, the requirement for end users to obtain interoperable CPE is nothing new. Addressing and maintaining connections with communicating parties is the traditional functionality of CPE. A subscriber to mobile service cannot engage in meaningful communication with a fax machine on the public switched network, and yet mobile service is an interconnected service. A subscriber to a one-way paging service may not transmit messages to or from another subscriber to a one-way paging service, and yet one-way paging is an interconnected service. Similarly, mobile broadband Internet access service is an interconnected service, because it gives subscribers the capability to communicate to or receive communications from *all* other

[160] *USTelecom* at 67.
[161] *USTelecom* at 67.
[162] *USTelecom* at 67.

users on the public switched network, providing that the parties have acquired the necessary services and CPE.

Finally, it is worth noting that mobile service (called "traditional wireless voice service" in the *NPRM*[163]) remains an interconnected service. An end user who has subscribed to mobile service has the capability to receive communications not only from subscribers to telephone exchange service and mobile service, but also from subscribers to broadband Internet access service. One option for doing so is for a subscriber to broadband Internet access service to use an app that is capable of address communicating parties and of setting up and maintaining connections with communicating parties, as discussed above. Another option for doing so, offered by most major mobile service providers, is an email-to-text feature of the service, in which a subscriber to broadband Internet access service may send an email to a mobile service subscriber and that message will be received as a text message.[164] Yet another option, which works with any mobile service provider, is to use an operating system such as Windows 10 that offers the ability to send text messages.[165] Finally, it is worth noting that the major mobile service providers no longer offer voice-only cell plans. Even their most basic plans include data.[166] Thus, anyone with almost any cell phone[167] on almost any recent cell phone plan has access to mobile broadband Internet access service.

2. This conclusion remains true if the Commission regresses to the outdated definition of public switched network.

If the Commission regresses to the outdated definition of *public switched network*, then a service is an interconnected service if it is interconnected with the public switched network and it gives subscribers the capability to communicate to or receive communications from other users on the public switched network, where the public switched network would revert to being defined as "[a]ny common carrier switched network, whether by wire or radio, including local exchange carriers, interexchange carriers, and mobile service providers, that use[s] the North American Numbering Plan in connection with the provision of switched services."

In that case, mobile broadband Internet access service is still an interconnected service. As above, mobile broadband Internet access service is *interconnected* with the public switched network, because it is connection through technologies such as store and forward that permits the transmission and reception of messages to and from points in the public switched network. This remains true for two independent reasons.

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[163] *NPRM*, para. 57 n. 146.

[164] See e.g. AT&T, "Send email as text message", available at https://www.att.com/esupport/article.html#!/wireless/KM1061254 (accessed Aug. 23, 2017) ("Send an email message to anyone with an AT&T wireless number that will be received as a text message on their phone or device"); T-Mobile, "Learn about text and picture messaging", available at https://support.t-mobile.com/docs/DOC-3309 (accessed Aug. 23, 2017) ("You can send messages to any email address, and you can have email sent to your mobile device via text message"); Verizon, "How to send text messages to Verizon customers from your PC", available at http://www.verizon.com/about/news/vzw/2013/06/computer-to-phone-text-messaging (accessed Aug. 23, 2017) ("Here's how to send a text message from a computer to fellow Verizon Wireless customer").

[165] See e.g. Microsoft, "Send a text message", available at https://support.microsoft.com/en-us/help/17266/windows-10-mobile-send-text-message (accessed Aug. 23, 2017) ("To send a text, on Start, select Messaging, and then New message . Enter a phone number or contact, type your message, and then select Send.").

[166] See e.g. Sprint, "Sprint single line cell phone plans", available at https://www.sprint.com/en/shop/plans/single-line-cell-phone-plans.html (accessed Aug. 23, 2017) ("2GB plan - $40/mo./line. The lowest price entry plan among national carriers."); Verizon, "Single Basic Phone Plan", available at https://www.verizonwireless.com/plans/single-device-plan/ (accessed Aug. 23, 2017) ("Unlimited Talk & Text, plus 500MB of data for $30/mo.").

[167] Today, even most basic (or "feature") phones are capable of transmitting and receiving data.

First, regardless of whether the Commission reverts to the outdated definition of public switched network, the network remains the same. As discussed in section 7.A, there is a single public switched network that includes the networks used to provision telephone exchange service, telephone toll service, mobile service, and broadband Internet access service. Limiting the definition to common carrier switched networks that use the North American Numbering Plan does not change the network itself. The networks remain physically connected. The access networks remain identical.

Second, as discussed in the previous subsection, an end user who has subscribed to mobile broadband Internet access service has the capability to communicate to and receive communications from all other users who are subscribers to other interconnected services over common carrier networks that use the North American Numbering Plan (e.g. telephone exchange service, telephone toll service, and mobile service), providing that the parties have acquired the necessary services and CPE. It similarly follows that mobile broadband Internet access service gives subscribers the capability to communicate to or receive communications from other users on the public switched network.